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ORIGINAL ARTICLE

Clinical effects of oral motor intervention combined with non-nutritive sucking on oral feeding in preterm infants with dysphagia

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KEYWORDS
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Abstract

Objective: To explore the effectiveness of oral motor intervention combined with non-nutritive sucking in treating premature infants with dysphagia.

Methods: Sixty preterm infants admitted to the neonatal intensive care unit of the present study's hospital were selected and randomly divided into the control and intervention groups. The control group was given non-nutritive sucking intervention alone, while the intervention group was given oral motor intervention combined with non-nutritive sucking. The oral motor ability, milk sucking amount and sucking rate, feeding efficiency and outcomes, and the occurrence of adverse reactions were measured and compared.

Results: Compared to first-day interventions, preterm infant oral feeding readiness assessment scale-Chinese version (PIOFRAS-CV) scores of the two groups significantly increased after 14 days of intervention, and this score was higher in the intervention group compared to the control group. Similarly, after 14 days of intervention, the intervention group's milk sucking rate and amount were significantly higher than the control group. Also, after the intervention, the intervention group's total oral feeding weeks were considerably lower, while the feeding efficiency and body weight were significantly higher than the control group. Moreover, the overall adverse reaction rate in the intervention group was lower than that in the control group.

Conclusions: Oral motor intervention combined with non-nutritive sucking can significantly improve the oral motor ability of premature newborns, promote the process of oral feeding, improve the outcome of oral feeding, and reduce the occurrence of adverse effects. The combined intervention seems to have a beneficial effect on oral feeding proficiency in preterm infants.

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Introduction

Preterm infants' survival rates have increased dramatically as medical technology has advanced.[1] Yet, most of them require admission to a neonatal intensive care unit (NICU) due to a range of medical and developmental issues.[2] Preterm infants often display difficulty establishing oral feeding in the weeks following birth. Sucking and swallowing functions begin to develop during the fetal period. Non-nutritive sucking begins at 15 weeks of pregnancy, and steady swallowing occurs between 22 and 24 weeks.[3] By 32-34 weeks of pregnancy, sucking-swallowing-breathing coordination is normally developed, and by 37 weeks of pregnancy, sucking-swallowing-breathing coordination is consistent.[4] Dysphagia is caused by life-threatening neonatal conditions such as premature delivery, cardiac disease, and neurologic abnormalities. As a result of better survival rates in children born preterm or with life-threatening medical conditions, there has been a significant surge in infants swallowing difficulties.[5] Furthermore, unfavorable feeding events such as intubation, tube feeding, or airway suctioning may obstruct the development of sucking and swallowing.

Most preterm infants have low body weight, immature brain development, sucking and swallowing problems, respiratory disorders, and decreased oral motor ability, which affects infants' growth and normal development.[6] Oral feeding is one of the most common nursing care interventions in the care of newborn infants. It is a complex multisystem process that involves the integration of lips, cheeks, tongue, jaw, pharynx, palate, and larynx.[7] Due to underdeveloped oral motor skills and a lack of coordination of sucking, swallowing, and respiration, preterm infants typically encounter oral-feeding anomalies.[4,8] Oral feeding problems have a considerable detrimental impact on children's growth and development and the well-being of their families.[9,10] Therefore, preterm infants should be given early corresponding intervention and treatment to avoid feeding intolerance, and reduce related gastrointestinal disorders, ectopic growth retardation, and other complications.

The feeding-specific oral motor intervention has recently received attention in NICUs due to its specifically tailored approach to oral structures involved in feeding. This intervention is mainly given by sensory stimulation of oral-related tissues, resulting in positive oropharyngeal stimulation, improved sucking and swallowing function, and reduced feeding-related disorders.[11,12] Previously, the effect of oral motor therapies on non-nutritive sucking (NNS), oral stimulation (OS), and the combined NNS/OS intervention have been investigated in a randomized clinical trial.[13] According to the findings, NNS alone boosted sucking pressure during oral feeding and reduced its time to transition from gavage to total oral feeding. Another study that focused on NNS only also found that preterm infants who received NNS had improved oral feeding performance and were in the hospital for a shorter period.[3] However, NNS has been shown to be less beneficial in preterm infants in terms of functional and oral feeding outcomes such as weight gain and growth.[14] Accordingly, several reports have demonstrated that the combination of NNS/OS resulted in positive changes in transition time, feeding performance, and volume intake at oral feeding outcomes.[15-17] However, the effect of NNS with OS on functional swallowing outcomes reported conflicting results, including a negative effect on weight gain.[18] Therefore, the aim of the present study was to explore the clinical effectiveness of oral motor intervention combined with NNS on premature infants with dysphagia.

Methods

Subjects

From January 2020 to January 2021, a total of 60 cases of preterm newborns in the NICU of the hospital were selected as the research subjects.

Ethics approval was obtained from the Institutional Review Board Ethics Committee of the present study's hospital. All methods were carried out in accordance with relevant guidelines and regulations. Informed consent was obtained from the infants' parents.

The subjects were randomly divided into intervention groups and control groups, with 30 cases in each group using a numerical random table method. The control group was given non-nutritive sucking intervention, while the intervention group was given oral motor intervention combined with non-nutritive sucking. The control group cases included 16 males and 14 females: gestational age of 29-35 weeks with average gestational age (32.36 $\pm$ 1.45) weeks. The birth weight was 1.41-2.39 kg with an average weight (1.73 $\pm$ 0.56) kg and the mode of delivery was: 12 cases of cesarean section and 18 cases of vaginal delivery. The average age of life was 1.72 $\pm$ 0.11 days. The intervention group included 17 males and 13 females: gestational age of 30-35 weeks with average gestational age (32.06 $\pm$ 1.53) weeks. The birth weight was 1.44-2.19 kg with an average weight (1.65 $\pm$ 0.44) kg and the mode of delivery was: 10 cases of cesarean section and 20 cases of vaginal delivery. The average age of life was 1.55 $\pm$ 0.12 days. Infants in both groups were on non-invasive respiratory support by continuous positive airway pressure (CPAP). Infants of both groups had similar morbidity during the first days of life. They were offered similar skin-to-skin contact since birth, similar breast contact, and were visited similarly by their parents. No significant differences were observed in these parameters between the two groups ($p > 0.05$).

Inclusion and exclusion criteria

Inclusion criteria

1) gestational age between 29-35 weeks as determined by obstetric ultrasonogram and clinical examination; 2) weak ability to swallow and sucking or full tube feeding; 3) stable

vital signs; 4) informed consent signed by parents of the infants. A total of 60 infants were recruited according to the inclusion criteria (Supplementary Fig. 1).

Exclusion criteria

Preterm infants with 1) congenital digestive tract malformation; 2) congenital heart disease; 3) nervous system malformation; 4) severe asphyxia; 5) severe infection and other serious complications.

Interventions

Preterm infants in the control group were allowed to suck on pacifiers for 8 ∼ 10 minutes, 3 times a day. On the contrary, infants in the intervention group were given oral motor intervention for 12 minutes according to the program proposed by Fucile et al.[15] and non-nutritive sucking for 8 ∼ 10 minutes, 3 times a day. The interventions were performed by professional and trained nursing staff. The oral motor intervention included: left and right cheek massage, upper lip massage, lower lip massage, machine directional reflex massage, tongue massage, palate massage, and gum massage. In addition, the nursing staff holds up the head, neck, and shoulder of the premature infant with their left hand when feeding the preterm infant, and then uses their right thumb to press the cheek of the preterm infant in the direction of the lip and use their right ring finger to press the other cheek to prevent the loss of milk. The interventions were given to all the infants in the two groups 30 minutes before their scheduled feeding time. The initial milk volume was between 3 ∼ 5 mL/time, feeding every 3 hours, each feeding time 8 ∼ 10 min, while the remaining milk was fed through the nasogastric tube. The sucking amount and sucking rate were adjusted according to the milk amount, feeding condition, and body mass index of preterm infants.

Outcome measures

1) Preterm infant oral feeding readiness assessment scale-Chinese version (PIOFRAS-CV)[19] was used to evaluate the oral motor ability of the two groups on the first day of the intervention, 7 days, and 14 days after the intervention. The PIOFRAS consists of five main categories including behavioral organization, oral reflexes, oral posture, corrected gestational age, and non-nutritive sucking. It has a total of 18 items and each item is scored from 0 to 2, for a maximum score of 36. A score of 0 means the infant lacks the optimal action. A score of 1 means they display inconsistent or insufficient optimal action. A score of 2 means the infant displays adequate optimal action. The higher the score, the better the oral motor ability.
2) The oral feeding process and outcomes were measured as the weeks of complete oral feeding, oral feeding efficiency, and gain in body weight after completion of oral feeding. The number of weeks of complete oral feeding was calculated as; weeks of complete oral feeding = corrected gestational age of complete oral feeding and corrected gestational age at the beginning of oral feeding. The feeding efficiency was measured as the average milk intake per minute of oral feeding.
3) The sucking amount and sucking rate of the two groups before and after the specified interventions were manually calculated and compared. The sucking amount was determined by measuring the remaining amount of the milk. The sucking rate was calculated by observing the time of sucking and the amount of sucking.
4) Adverse reactions (apnea, abdominal distension, decreased oxygen saturation, and vomiting) during the intervention were measured in the two groups. The overall incidence of adverse reaction rate was calculated as follows: The overall adverse reaction rate = the number of cases of adverse reactions (apnea, abdominal distension, decreased oxygen saturation, and vomiting) in each group / total number of cases in each group × 100%.

Statistical analysis

Data were analyzed by SPSS 20.0 software. The measurement data were analyzed using a t-test and expressed as $x \pm s$. The count data was determined by the χ^2 test and expressed as a percentage. $p < 0.05$ was considered statistically significant.

Results

Oral motor ability

On the first day of the intervention, there was no noticeable difference in the PIOFRAS-CV scores between the control and intervention groups ($p > 0.05$). However, after 7 and 14 days of intervention, the PIOFRAS-CV scores of the two groups were significantly increased ($p < 0.05$) compared to the day first intervention. Notably, the PIOFRAS-CV score of the intervention group was prominently higher than the control group after 7 and 14 days of intervention, and this difference was statistically significant ($p < 0.05$; Table 1). Most

Table 1 Comparison of the PIOFRA S-CV scores between the two groups.

Groups	n	First day of intervention	7 days post-intervention	14 days post-intervention	χ^2	p
Control group	30	25.15 ± 2.12	29.81 ± 2.73[a]	33.33 ± 3.32[a]	46.450	< 0.001
Intervention group	30	25.23 ± 2.27	33.16 ± 2.86[a,b]	38.07 ± 3.21[a,b]	82.150	< 0.001
t		0.833	4.158	6.630		
P		0.641	< 0.001	< 0.001		

[a] Indicates a significant difference between day first and day 7 post-intervention. Indicates a significant difference between the control and intervention groups at day 7 and day 14 post-intervention.
[b] Indicates a significant difference between day 7 and day 14 post-intervention.

importantly, the PIOFRAS-CV scores of the two groups after 14 days of intervention were higher ($p < 0.05$) than the 7 days post-intervention. Besides, the intervention group had a better oral motor ability score than the control group ($p < 0.05$). Therefore, the authors measured other parameters at 14 days of intervention in the subsequent analysis.

Oral feeding process and outcomes

After 14 days of intervention, a significant decrease was observed in the weeks of complete oral feeding in the intervention group compared to the control group ($p < 0.05$). Similarly, a considerable increase in the oral feeding efficiency and body weight was seen in the intervention group compared to the control group ($p < 0.05$; Table 2).

Sucking amount and sucking rate

Before the intervention, there was no significant difference in the sucking amount and sucking rate between the two groups ($p > 0.05$). In contrast, after the 14 days of intervention, the sucking amount and sucking rate of the two groups significantly improved compared to before the intervention ($p < 0.05$). Notably, these parameters were prominently improved in the intervention group compared to the control group ($p < 0.05$; Table 3).

Adverse reactions outcomes

After 14 days of intervention, the incidence of adverse reactions, including apnea, abdominal distension, and decreased blood oxygen saturation other than vomiting, was lower in the intervention group than that in the control group, and the difference was statistically significant ($p < 0.05$; Table 4). While there was no significant difference in the amplitude of desaturations (during the diagnostic night) 5.43% vs 5.71%, ($p < 0.05$) between the control and intervention groups.

Discussion

Studies have shown that after oral intervention in preterm infants, the amount of sucking, the rate of sucking, weight at discharge, and the time to return to normal weight are better than those of preterm infants who receive conventional feeding methods, suggesting that oral intervention can significantly improve sucking function, optimize its feeding performance, enhance its sucking and swallowing functions, promote the recovery of preterm infants' weight, and create conditions for their growth and development.[13,20] Here, the authors demonstrated that the PIOFRAS-CV scores of the intervention group were higher than those of the control group after 7 days and 14 days of oral motor intervention. Comparably, the number of weeks of complete oral feeding was less than those of the control group, while the feeding efficiency of complete oral feeding and the bodyweight of preterm infants after completing the intervention were higher than that of the control group. These results are in accordance with previous studies showing that early oral motor intervention combined with non-nutritive sucking can improve the oral motor ability of ultra-low birth weight newborns, improve their oral feeding performance, and effectively shorten the transition time of oral feeding.[3,20,21] Previously, it has been shown that infants should be given oral feeding while on stable CPAP.[22] In the present study, the infants were also on CPAP during oral feeding, however, delaying oral feeding until coming off nasal CPAP has been shown not to faster maturation of oral feeding ability, or decreased length of stay.[23] The reality, on the other hand, is more complicated,[24] necessitating a deliberate approach,[25] since aggressive early feeding may cause undue stress in these newborns, leading to further setbacks.

Clinically, total milk intake and milk delivery rate are critical indicators to reflect preterm infants' sucking, swallowing, and respiratory coordination function.[21] The present study's results also showed that there was no significant difference in the amount of sucking and sucking rate between the two groups before the intervention, but after the intervention, the amount of milk sucking and sucking rate in the

Table 2 Comparison of oral feeding process and outcomes between the two groups.

Groups	n	Weeks of oral feeding (weeks)	Oral feeding efficiency (mL/min)	Gain in body weight (kg)
Control group	3	2.78 ± 0.47	10.35 ± 3.72	1.08 ± 0.39
Intervention group	3	2.04 ± 0.57	12.24 ± 3.18	1.82 ± 0.41
t		7.853	3.772	10.468
P		< 0.001	< 0.001	< 0.001

Table 3 Comparison of sucking amount and sucking rate between the two groups.

Groups	n	Sucking amount (mL)		Sucking rate (mL/min)	
		Before intervention	After intervention	Before intervention	After intervention
Control group	30	22.7 ± 7.2	41.4 ± 6.7[a]	1.5 ± 0.5	5.8 ± 1.4[a]
Intervention group	30	22.9 ± 7.7	48.8 ± 6.0[a,b]	1.6 ± 0.4	7.7 ± 0.9[a,b]
t		0.483	7.347	0.0108	10.263
P		> 0.05	< 0.001	> 0.05	< 0.001

[a] Indicates a significant difference between before and after the intervention.
[b] Indicates a significant difference between the control and intervention groups after 14 days post-intervention.

Table 4 Comparison of adverse reactions between the two groups.

Groups	n	Apnea	Abdominal distension	Decreased oxygen saturation	Vomiting	Overall adverse reaction rate
Control group	30	1 (3.33%)	2 (6.66%)	2 (6.66%)	0 (0%)	16.66%
Intervention group	30	0 (0%)	1 (3.33%)	0 (0%)	1 (3.33%)	6.66%

intervention group were significantly higher than the control group. These results confirm that oral motor intervention combined with non-nutritive sucking could improve the feeding performance of preterm infants with sucking and swallowing dysfunction, which is in agreement with the results of a previous study investigating the effects of a new motorized 'pulsating' pacifier in preterm infants.[26] In addition, compared with the control group, the incidence of adverse reactions, including apnea, abdominal distension, decreased blood oxygen saturation, and vomiting was significantly lower in the intervention group. Apnea, reduced oxygen saturation, abdominal distension, and vomiting are the adverse reactions of preterm infants during feeding. The occurrence of abdominal distension and vomiting in meager weight premature infants can affect gastrointestinal feeding and hinder their growth and development.[27] However, early oral motor intervention can stimulate nerve fibers in children's mouths, excite the vagus nerve, enhance gastrointestinal activity, increase the secretion of insulin and motilin, promote the development of gastrointestinal mucosa, and effectively reduce the occurrence of adverse reactions during feeding.[28-30]

In summary, oral motor intervention combined with non-nutritive sucking can significantly improve sucking, swallowing, and breathing coordination of premature infants with sucking and swallowing dysfunction and ultimately play a substantial role in enhancing feeding performance, which is worthy of clinical promotion and application.

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Conflicts of interest

The authors declare no conflicts of interest.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jped.2022.02.005.

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